

(6 pages)

DECEMBER 2014

P/ID 40010/PPHK

Time : Three hours

Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Explain why di-proton or di-neutron does not exist.
2. Write a short note on Mass parabola.
3. What you mean by pair production?
4. Give the properties of the nuclear forces.
5. Explain why it is not possible to have a $0^+ \rightarrow 0^+$ in γ - transition.
6. What is helicity of neutrino?
7. Write a short note on super allowed transitions.
8. Expand the given nuclear reaction $^{13}\text{C}(p, X)^{10}\text{B}$ and find the unknown particle(X).

9. Define isospin.
10. Determine the charges of the u and d quarks from the quark structure of a neutron.

PART B — (5 × 6 = 30 marks)

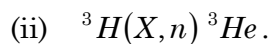
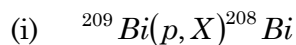
Answer ALL questions.

11. (a) Explain the charge independence and the spin dependence of nuclear forces.

Or

- (b) Discuss the effective range theory of n-p scattering.

12. (a) Find the unknown Particle (X) and determine the Q-value in the following nuclear reaction



Or

- (b) Discuss briefly the various types of the direct reactions with suitable examples.

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13. (a) Describe the expression for nuclear magnetic moments based on Schmidt model.

Or

- (b) Discuss the salient features of the collective model.

14. (a) Classify the nuclear transitions in Beta decay based on Fermi and Gamow-Teller Transitions. Discuss the allowed and forbidden transitions with suitable examples.

Or

- (b) Determine the multipolarities in gamma decay using angular correlation techniques.

15. (a) Discuss overview of parity in weak interactions.

Or

- (b) What are hadrons? Discuss their SU(3) classifications.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

16. (a) With a square well potential, derive an expression for the binding energy of a deuteron, as a function of the depth and width of the potential.

Or

- (b) Describe the basic ideas in Yukawa's meson exchange theory of nuclear forces. From the Yukawa theory form, If a nucleon emits a virtual pions of rest mass $270 m_e$, estimate the range of nuclear force.

17. (a) Obtain scattering and reaction cross sections.

Or

- (b) Describe the Breit-Wigner dispersion formula for σ_r (the reaction cross section) and σ_s (the scattering cross section) for spinless neutrons.

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[P.T.O.]

18. (a) Discuss the Bohr-Wheeler theory of fission and find the condition for spontaneous fission.

Or

- (b) Discuss the Nuclear Shell Model and present the nuclear energy level scheme, with a suitable potential. Explain how the L.S interaction helps us to reproduce the magic number in Shell model.

19. (a) Discuss Fermi's theory of beta decay and explain the continuous beta spectrum.

Or

- (b) (i) What are the selection rules for gamma decay? Illustrate with examples.

- (ii) Write note on Internal conversion and nuclear Isomerism.

20. (a) What is CP invariance ? Combined operation of charge and space or simultaneous reversal of charge and position coordinate on the particle.

Or

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- (b) (i) What are Fermions and Bosons? Discuss the classification of Fermions and Bosons.
- (ii) Discuss Weak Interactions in detail. Illustrate with examples.
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